28th Congress, 1st Session. Doc. No. 146. Ho. of Reps Navy Dept.

DRY DOCK—NEW YORK HARBOR.

REPORT

OF

THE SECRETARY OF THE NAVY,

RELATIVE TO

The construction of a dry dock in New York harbor, upon the plan of using, as an elevating power, the water of the Croton aqueduct, &c.

FEBRUARY 19, 1844.

Read, and referred to the Committee on Naval Affairs.

NAVY DEPARTMENT, *February* 12, 1844.

SIR: In obedience to the requirements of an act of the Congress of the United States, passed March 3, 1843, in these words:

"And the Secretary of the Navy is hereby directed to cause an examination to be made of the expediency, practicability, and probable expense, of constructing a dry dock in the harbor of New York, upon the plan of using, as an elevating power, the water of the Croton aqueduct, and of sufficient capacity to rebuild or repair a 74-gun ship; and to cause an examination of any other plan or plans of a dry dock, or floating dock, in said harbor, deemed worthy by the Secretary to be reported upon; and to report the result of such examination, with his opinion thereon, to the next session of Congress;"—

The Secretary of the Navy has the honor to report that, in October last, the engineer in the Bureau of Yards and Docks, Wm. P. S. Sanger, esq., was directed to make the necessary examinations of sites for the proposed Croton-water dock. He was assisted in his arduous labors by Messrs. George F. De la Roche and Calvin Brown, scientific engineers and draughtsmen, employed in the civil department of the naval service.

Three sites were examined within the limits of the city of New York, with reference to the use of the Croton water as an elevating power.

The first was at Belleviue, on the alms-house lot.

Though this site contains room enough for a dock, it is not sufficiently spacious for a navy-yard; and has the further objection of flats or shoals in front, which would prevent the access of the larger ships of war; and the bed of the river at this point being rock, covered only by a thin deposite of mud, excavation, for the purpose of deepening the channel, would be impracticable; and the site is not considered suitable. The plan of this site accompanies Mr. Sanger's report, marked No. 1.

Blair & Rives, print.

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The second point examined was at Kip's bay. Here a depth of water is found sufficient to float the largest ships at all times of the tide, and the site is beyond any injurious influence from the currents caused by the waters flowing through Hellgate. It is also sufficiently near to the central parts of the city to obtain readily workmen and materials. The grounds about this site, however, are very irregular; and the grading for a navy-yard, and the rock excavations for a dock, would be very expensive. Plan No. 2, accompanying Mr. Sanger's report, exhibits the form and features of this site. Plan No. 3 represents the arrangement of the dock.

Harlaem cove, at the mouth of the Harlaem river, and opposite to the south end of Great Barn island, was next examined. This site is shown on plan No. 4. of Mr. Sanger. The larger portion of the ground being a low marsh covered with water at ordinary high tides, and the mud being some twenty feet deep, would require great expense in filling and in piling for solid foundations.

The estimated cost of a dock at this site is $1,716,996.

There would be great danger in approaching this point with ships, owing to the rapid currents in and about Hellgate. This site was examined by a commissioner in 1836, and reported as unfavorable; which opinion is confirmed by Mr. Sanger.

It will be perceived, from the report of the engineers, that it is practicable to construct a dry dock in New York, upon the plan of using the Croton water as an elevating power. The expenses of such a work for one dock at Kip's bay (the only point examined, where it is considered safe to construct the work) is estimated at $1,580,835, exclusive of the cost of land, and of the water to be obtained from the Croton reservoir, of the amount of which no reliable estimates could be procured. The expediency of constructing such a work remains to be considered.

One of the principal advantages of a lock-dock over the excavated dock, where the tides do not drain the excavated dock at their ebb, was formerly considered to be their easy drainage; but, since the introduction of pumps driven by steam-power, this advantage has become of minor importance, and the cost of procuring the Croton water, it is believed, would exceed the expense of draining by steam. A lock-dock would, undoubtedly, be drier than an excavated dock, which must always be more or less wet, from the constant oozing in of the tide.

Another advantage resulting from the elevated and dry position of lock-docks, is, that houses can be erected over them, and the ships be thus kept from the action of the water and the weather at the same time. But these advantages, it is believed, may be obtained in a more effective and cheaper mode, by a plan which will be spoken of in another part of this report.

The expense of a lock-dock at Kip's bay, or at any other point, would be very large, and, without a navy-yard connected with it, the advantages would be limited. To connect with it a navy-yard, would require the erection of workshops, ship-houses, storehouses, and machinery, indispensable in such an establishment; and it would also supersede and render useless the like kind of works, which have been built at the Brooklyn yard at a cost of more than a million of dollars.

After a careful examination of the several reports made at different times by the commissioners and engineers who have had the subject of a new location for a navy-yard on the waters of New York confided to them, and de liberate consideration of the different points discussed and explained in

those reports, the conclusion seems forced upon the mind that it is inexpedient to change the location of the navy-yard at Brooklyn, and that the Croton water cannot be beneficially used as an elevating power for a dry dock.

The Secretary of the Navy was directed, in the said resolve, to cause an examination of any other plan or plans of a dry dock, or floating dock, in said harbor, deemed worthy by the Secretary to be reported upon, and to report the result of such examination, with his opinion thereon, to the next session of Congress.

There have been two such plans of docks examined: first, the ordinary excavated stone dock, similar to those at Charlestown and Norfolk; and the sectional floating dock.

In the early history of the navy, the repairs and examinations in bottoms of ships were made by heaving the ship down—a process both costly and hazardous. Early efforts were made by the Government to introduce the use of the dry dock, both for repairs and shelter. In a report of the Secretary of the Navy, in December, 1798, it is said: "Docks will be highly necessary in repairing our ships, to avoid the tedious, expensive, and sometimes dangerous operation of heaving down. They can undoubtedly be made in eastern States, where the tides rise very considerably—probably in New Hampshire, Massachusetts, and Rhode Island. Whether they can be made with equal advantage, or to answer valuable purposes, to the southward of Rhode Island or New York, I cannot form an accurate judgment from any information I possess; though it would unquestionably be a great public advantage to have a dock at the entrance into the Chesapeake bay, and another still further south, if circumstances will permit"

In President Jefferson's message of December 15, 1802, speaking of the same subject, he says: "Presuming it will be deemed expedient to expend annually a convenient sum towards providing the naval force which our situation may require, I cannot but recommend that the first appropriations for that purpose may go to the saving what we already possess. No cares, no attentions can preserve vessels from rapid decay, which lie in water, exposed to the sun. These decays require great and constant repairs, and will consume, if continued, a great portion of the moneys destined to naval purposes. To avoid this waste of our resources, it is proposed to add to our navy-yard here a dock, within which our present vessels may be laid up dry, and under cover from the sun. Under these circumstances, experience proves that works of wood will remain scarcely at all affected by time. The great abundance of running water which this situation possesses, at heights far above the level of the tide, if employed as is practised for lock navigation, furnishes the means for raising and laying up our vessels on a dry and sheltered bed; and should the measure be found useful here, similar depositories for laying up, as well as for building and repairing vessels, may hereafter be undertaken at other yards offering the same means."

Before the introduction of steam-power for the purpose of drainage, it was deemed important to place a dock where the ebb and flow of the tide were sufficient to float a ship into the dock, and drain it by the same natural power; or to place the ship by lockage so high, that the dock would be drained by opening its sluice-ways. Since the introduction of steam-power excavated docks are kept tolerably well drained at a cheap rate, even where their beds are below the surface of the water, by pumping.

The general advantages of docking, over the old mode of heaving down, consist in the safety to the ship, and facility to the workmen in examining

and repairing ships' bottoms; in economy of time and expense; and in the opportunity it affords of a more thorough examination of the defective parts.

The first dock in the United States was built in Charlestown, and is capable of docking the largest ships. The estimated cost, as stated in the report of engineer Loammi Baldwin, esq., was $280,089; the actual cost was $677,089. The cost of the dock at Norfolk was $962,459. Both these are stone docks.

No detailed estimate of the cost of constructing a dry dock at the Brooklyn yard has come under the notice of the undersigned. Mr. Baldwin, in his report to the department, dated December 10, 1836, says upon this subject:

"The cost of a dry dock, I have learned from experience, is wholly out of your reach by the ordinary calculations of detail. * * * *

"The closest calculations can never be so safe, for your present purposes, as that of taking the mean cost of the two docks, already built at Boston and Norfolk.

The dry dock at Boston, including all expenses, cost -	$677,089 78
The dry dock at Norfolk, including all expenses - -	962,459 19
	1,639,548 97
Mean cost - - - - - -	819,774 48

* * * * * * * * *

"Hence I cannot assume safer data, that I, or any other engineer, I believe, can furnish, than $820,000, for the cost of a dry dock at either site in question."

This estimate is exclusive of the excavation of the channel, and crib-work, to secure a suitable depth of water at the Brooklyn yard.

Mr. Sanger estimates the cost for the like work, for the dock, $750,000, and the crib-work at $100,000; but it does not appear, in his report, that this sum is derived from any estimate of the details of cost.

Excavated stone docks, in this country, where the tides do not rise many feet, have but partially met the wants of the ship-builders. Besides, they are costly, confined for room, dark, and damp. They do, indeed, answer for single ships; but the ship-building interest (one of the most important branches of human industry, viewed in all its bearings, upon the welfare of the human family) has long needed, and labored to discover some plan by which vessels could be built on level ways, and thence launched into their destined element, without the racking and straining always incident to the ordinary mode of building and launching from inclined planes; a plan that would likewise enable them safely to raise vessels vertically from the water, and place them high and dry, for repairs or preservation. It is true, a vessel can be thus built and launched from the excavated stone dock; but such a dock is entirely too expensive to be used for such a purpose, and such a length of time as would be required to build a large ship.

Various inventions have been essayed for the purpose of reaching so desirable a result; and floating docks, on different models, have been built, and successfully used, for a number of years, in raising, repairing, and launching merchant vessels, and the smaller vessels of war. No attempt has been made to build ships on the floating docks; they have been used only to raise and repair them. There was still a want unsupplied—a plan

by which vessels, when thus raised, could be safely transferred to dry land and housed; a plan by which vessels could be built, standing vertically, and thus launched—avoiding the liabilities of strain, hogging, and warping, incident to the building and launching from the inclined ways. This desirable and important object, long so fruitlessly sought, it is believed has been attained by the invention of the sectional floating dock, connected with a permanent basin and level rail track. Vessels of the largest size may be raised from the water, on this dock, used as the elevating power; the dock floated into its basin, settled on its permanent foundation, and the ship thence transferred to the land, and again safely placed upon the dock, and lowered into the water, never losing its upright position.

S. D. Dakin, esq., of New York, has presented a plan of this dock, and exhibited a working model of it, to the department; which seems to promise the accomplishment of the great object so long sought in the business of ship building.

The dock here spoken of—not connected with the proposed improvement of a permanent basin and railway—has been in successful operation for several years in New York; and has raised, and had repaired on it, numerous vessels, some of large size and great length, without having experienced any accident, either to the ships or the dock.

A personal examination of the sectional dock and its working power in raising and lowering a vessel of more than six hundred tons, made by the undersigned, at New York, during the last season, proved to him very satisfactory and conclusive in favor of the utility of the invention.

The proprietors claim that this dock possesses the following advantages:

"1st. A perfect adaptation of the supporting power of the dock to the actual shape of the vessel's bottom."

This is a great practical advantage, understood more fully by shipwrights than by other persons. They all agree in saying that artificial methods of adjusting keel blocks in a rigid line to the shape of the keel, however plausible in theory, do not work well in practice; and that nothing hitherto devised can compare, in this respect, with the sectional buoyant platforms of this dock, which are themselves buoyed up by the very pressure of the water that sustains the vessel when afloat; and each acting independent of the rest, though all in concert, must necessarily hold her in her floating shape.

"2d. Abundance of room, light, and air, around the vessel's bottom."

The advantage in this respect is so great, that shipwrights unite in declaring that it enables them to perform their work from 15 to 20 per cent. cheaper on this, than on any other dock, and to inspect the minutest damages or defects of the vessel's bottom.

"3d. Ability of being elongated or contracted, according to the length of the vessel, and of being separated, by taking the sections apart, into two or more docks, and thus performing a great deal more efficient service than any other dock.

"4th. The facility with which it can be repaired, by raising one section at a time, on two others.

"5th. The short time required for its construction—not being more than 8 or 10 months.

"6th. Its entire independence of the tides—being capable of operating at all tides.

"7th. The small expense of working it, depending upon the size of the vessels; whereas, in a stone dock, the smaller the vessel, the more the expense.

"8th. Its ability to sink without ballast; and, in sinking or rising, to maintain its equilibrium, and any required position, by means of its movable and controlling end floats.

"9th. Its adaptation, attained by its sectional arrangement, to make timber and iron exert their strength in the most effective and economical manner, and secure the structure against the risk of an overwhelming strain bearing upon any one point. Each section is, indeed, with a limited lifting power, to which its strength is adapted, acting independently, and yielding in the water if any pressure beyond that amount tends to come upon it.

"10th. Ability to be easily moved from place to place—an advantage at all times of much convenience, and, in case of an anticipated attack on the navy-yard, of the greatest moment."

Such are the advantages claimed for this dock, independent of any connexion with a permanent platform and rail-track.

The engineer, Mr. Sanger, was directed to examine the Brooklyn yard, in reference to the practicability of using this dock and rail-track at that yard.

His report to the department, herewith transmitted, presents a detail of facts connected with the subject. A dock capable of lifting the ship Pennsylvania, of 120 guns, weighing, when ready for sea, 5,200 tons, with permanent basin, bed way, rail-track, and all the necessary machinery to work it, can be built for $497,000, and requires forty feet of water to raise her.

The cost of dredging and crib-work, to accommodate this structure, at the Brooklyn yard, would be about the same as would be required if a stone dock were built there. The cost of a sectional dock, with all the above-named appendages, sufficient to raise the Pennsylvania, relieved of the weight of her armament and stores, (weighing, in that state, 2,876 tons,) would cost $485,000, and require 32 feet water to raise the ship, and but 14 feet to float her in, and bed her on the permanent basin.

A dock to lift a second-class frigate, with dock machinery and one rail-track, complete, can be built for $180,000.

An excavated stone dock can accommodate, ordinarily, but one vessel at a time, and, during war, would hardly afford the facilities that would be needed. The Navy Commissioners, in a report dated February 17, 1836, state that it might require 12,000 days' labor to repair the bottom of a 74—working in the longest days of the summer. In such a case, many weeks, if not months, must elapse before such a vessel could be taken from the dock, owing to the comparatively small number of persons who could work upon her at once in so confined a place.

The sectional floating-dock, with rail-tracks, could accommodate many vessels at once, where they would be placed with ample room, light, and air around them, and giving every facility for working with despatch.

The object so strongly desired in Mr. Jefferson's message, before quoted—that our vessels may be laid up dry, and under cover from the sun, and which he hoped to obtain by the means of lock-docks—it is believed may be much better, and much more cheaply obtained, by the sectional dock and railway.

All experience verifies the remark of Mr. Jefferson, that "no cares, no

attentions can preserve vessels from rapid decay, which lie in water, exposed to the sun;" and that works of wood, laid up dry, will remain scarcely affected by time.

Some of the most costly ships of our navy have rotted, and been broken up, seeing little more service than lying at the wharves; while others, built about the same periods, remain comparatively uninjured, in the houses in which they were built.

It is believed that the sectional dock and railways will not only answer for the repairs of ships, better than any other plan yet devised, but that they will become the only building-ways; and that, instead of letting our ships, when not in use, lie and decay at the navy-yards, in ordinary, they will be raised from the water, and placed under cover, protected from the weather, upon the rail-tracks.

The plan of the sectional dock and railway commends itself to favor by its cheapness and simplicity; and if, on trial, it realizes what has been promised from its use, it will enable the Government to construct, at a moderate cost, a dock at each of the navy-yards, capable of accommodating a number of ships at once.

After carefully considering the facts, statements, and opinions which have been presented to the department, at different periods, by the officers and others who have had the subject of a dry-dock at the Brooklyn yard under investigation, the undersigned is fully persuaded that the plan of dock of Mr. Dakin, here spoken of, is worthy of trial on a scale sufficiently large for raising the largest ships.

A copy of a letter from Foster Rhodes, esq., the naval constructor at Norfolk, is appended, as likewise the report of Mr. Sanger.

All of which is respectfully submitted:

DAVID HENSHAW.

Hon. JOHN W. JONES,
Speaker of the House of Representatives.

GOSPORT, VA., *January* 22, 1844.

DEAR SIR: I received on Saturday your letter and pamphlet—"Plan and Advantages of a Sectional Dry Dock," &c.; for which please accept my thanks.

The lithograph enables me fully to comprehend the important improvements you have therein delineated. The mode by which you propose to take the vessel from the dock to the land, for the purpose of repair or safe-keeping, and again to put her in the water, is much more simple and effective than anything that I suggested last winter to Mr. Bayard, the intelligent chairman of the Committee on Naval Affairs in the Senate.

In examining the plan, and reading your letter, I cannot but feel flattered in seeing my recommendation to Messrs. Dakin and Burgess, of having the centre tank in one, and the truss or frame enclosed within it, for additional strength, so fully carried out. With regard to a location, I do not think any place equal to the Brooklyn yard for naval purposes, (if a floating dock is to be adopted,) where a basin may be dug with the greatest ease, either in the meadows, or in the flat in front of the yard, where there is abundant room for piers, slips, &c.

In looking over your whole plan, it may be termed a magnificent one, truly; and although it may be drawn out too far for the navy of the pres-

ent day, it is on a principle that can be extended as the wants of the service may require it.

The principles, details, and practicability of the plan of the dock, basin, platforms, &c., are highly creditable to the intelligence, industry, and practical knowledge of yourself and your associates.

Very respectfully, your obedient servant,

FOSTER RHODES.

R. MOODY, Esq., *Washington, D. C.*

WASHINGTON, *January* 23, 1844.

SIR: In compliance with your order of the 30th October last, directing an examination of several points on the East river, in the harbor of New York, in reference to the construction of a dry dock, using the water of the Croton aqueduct as an elevating power, &c., I have performed the duty assigned, and respectfully report:

The point first examined was the alms house at Bellevue. These grounds are bounded on the south by Twenty third street, west by the Second avenue, north by Twenty-eighth street, and on the east by the East river; the boundary wall enclosing thirty-seven acres, nearly. This space would be sufficiently large for a dry dock, but would be entirely too limited for a navy-yard. The plan marked No. 1, herewith submitted, exhibits the boundaries of this ground, with the positions of the ground-plans of the several buildings now in existence; also, the levels of the land above ordinary high-water mark, and the depths of water below the same point. Upon an examination of this plan, it will be seen that in front of these grounds there is an extensive flat, upon which the best water at ordinary high tide does not exceed twenty-three feet; this depth of water would not be sufficient for naval purposes, as a ship-of-the-line could not approach the shore at high water. The bottom of the river at this point is rock, covered with a small depth of mud; and an excavation of this flat to a sufficient depth would be attended with an enormous expense, and great uncertainty of success. I am, therefore, of the opinion, that the construction of a dry dock at this point, of sufficient capacity for admitting ships of the largest class, would be impracticable for useful purposes.

The second point which was examined was at Kip's bay; the grounds included in this survey are bounded on the south by Thirty-third street, and east by East river. Opposite this point, and below it, there is an abundant depth of water for the accommodation of the largest ships at all times; this site is situated so far below the Great Hellgate as to be beyond the influence of the rapid current produced by that contracted and dangerous passage; and it is believed that vessels of war may approach or leave this place at all times, with safety, and without detention. The distance from Kip's bay to the central part of the city is so small, that workmen, seamen, materials, or supplies may be obtained without difficulty. The plan marked No. 2 exhibits the boundaries of this survey, and shows the levels of the land above ordinary high water, and also the soundings below the same point. The ground enclosed by the above boundaries is very irregular and uneven, the soil on an average not exceeding four feet in depth, and the bottom is rock. The construction of a dry dock at this point would be practicable, but very expensive. In order to form an estimate of the probable cost of con-

structing a dry dock upon the proposed principle, it was necessary to adopt some plan of construction as a guide; and as none had been presented, I have prepared such an arrangement as would afford great facilities for the performance of a large amount of work. By this plan it is proposed to build a lock and basin of sufficient capacity to admit the largest ships, and to allow them to be turned in any direction; around this basin are sites for five dry docks, one of which may be constructed with the basin, and the remainder at such times as the future exigencies of the service may require. The plan marked No. 3 represents this arrangement, and the following is an estimate of the probable cost of building the lock, basin, and one dry dock:

Cost of coffer-dam	$20,358 05
temporary drainage	38,675 00
excavation and foundation	208,382 74
masonry	799,996 13
turning gates for locks	46,754 16
floating-gate	30,000 00
culvert-gates and fixtures	741 81
capstans	1,436 65
embankment and surface drainage	60,142 28
miscellaneous objects	167,000 00
contingencies	137,348 68
pipe for reservoir	70,000 00
Cost of basin and one dry dock	$1,580,835 50

After completing the survey at Kip's bay, I next proceeded to examine the proposed site at Harlaem. The lands included in this survey are bounded south by Ninety-fourth street, west by the Third avenue, north by One-hundred-and-fourth street, and east by Harlaem cove, or the mouth of Harlaem river. This location is directly opposite the south end of Great Barn island and Hellgate—an extension of the south boundary-line running across Little Mill-rock. Most of the ground included within these limits is a low meadow, which is covered at ordinary high tide; the plan (marked No. 4) shows the boundaries of these meadows, and the depths of soundings below ordinary high tide. The water along the front of this site is very deep, the channel being swept out by the rapid currents which constantly rush through the well-known passage called Hellgate. The meadow is very soft; and, upon sounding the mud, an iron rod was inserted twenty feet before meeting with any serious obstruction, and, consequently, all constructions would require a foundation of piles. The erection of a dry dock at this point would be practicable; and a work similar to that proposed at Kip's bay would probably cost the following amounts:

Cost of coffer-dam	$61,817 50
temporary drainage	38,675 00
excavation	55,036 40
foundation	139,236 85
masonry	898,465 13
turning gates for lock	46,754 16
floating-gate	30,000 00
culvert-gates and fixtures	741 81
capstans	1,436 65

Cost of embankment and surface drainage - -	$58,106 40
miscellaneous objects - - - -	167,000 00
contingencies - - - - -	149,726 99
pipe for reservoir - - - -	70,000 00
Cost of basin and one dry dock - - -	$1,716,996 89

Having expressed an opinion with regard to the practicability and probable cost of constructing a dry dock at the several points under examination, the only remaining question for consideration is that of expediency.

The selection of a suitable site for a dry dock and extensive naval establishment, in the harbor of New York, is a subject which has long engaged the attention of the department, and upon which many able reports have been made by distinguished naval officers, and by engineers of known scientific and practical knowledge; and the great and increasing necessity for the speedy erection of a dock in that harbor has been so often and ably discussed, that it is believed no further arguments in support of the proposition are now necessary. Those who have examined the subject with attention, concur in the opinion that a dry dock is a necessary appendage to a navy-yard, and that the separation of a dock from the other parts of a complete and well-ordered yard is inadmissible; the dry dock is, in fact, an immense workshop, where the ship is placed in security, and where all the various branches of work, necessary in fitting and repairing, are progressing at the same time: hence it becomes necessary that all the different work shops, timber-sheds, store houses, and offices should be located in the immediate neighborhood of the dock. The site at Kip's bay is situated three miles, and that at Harlaem six miles, distant from the present navy-yard at Brooklyn, as will be seen by a reference to the map No. 5. Should either of these points be selected, and a dry dock constructed, the expense of erecting all the requisite workshops, timber-sheds, and store houses would unavoidably follow, as the great inconvenience, loss of time, and expense incurred in the transportation of workmen and materials from the navy-yard to the dry dock, would render such constructions indispensably necessary. The erection of a dock at either of the points under examination would obviously lead to the expenditure of large appropriations for other objects, the final relinquishment of the present yard at Brooklyn, and loss of the amounts already expended upon the permanent improvements now completed at that station. In deciding the question of expediency, it will, therefore, be necessary to take into consideration the amount already expended upon the improvements at the Brooklyn yard, and to ascertain whether either of the proposed locations possesses advantages of sufficient magnitude to warrant the sacrifice of these improvements; the amount expended at Brooklyn, up to the present time, including the original cost of the land, (as ascertained from an authentic source,) is $1,159,229 67.

The advantages possessed by the position at Kip's bay are—great depth of water, there being at all times of tide sufficient depth to accommodate the largest ships; ample space for the erection of all buildings necessary in a well-arranged navy-yard; it is conveniently near to a large city, where workmen, seamen, and materials may be at all times procured; and it may be considered secure from attack by an enemy. At the Brooklyn yard a large number of buildings and improvements necessary in a dock-yard are now erected; and it is believed that a reasonable appropriation, judiciously

expended in the construction of a dry dock, in the erection of a crib work around the Wallabout flats, and in dredging out the channel, would render this one of the most safe, complete, and convenient yards in the country. I have no hesitation in stating, as my opinion, that a dry dock, equal in all respects to that at Charlestown, may be built at Brooklyn for the sum of $750,000; and that a further appropriation of $100,000 will defray the expenses of constructing a crib work, and dredging out the channel to such an extent as will, in future, secure an ample depth of water around the yard. The only advantage supposed to be possessed by the elevating dock over the ordinary dry dock, is the difference in the expense of erecting steam engines, pumps, wells, and engine-house, and the cost of maintaining them in operation, compared with the cost of pipes and a supply of water.

The cost of steam engines, pumps, wells, and engine house, at the Norfolk dock, was $75,609 21. The cost of the same works at the Charlestown dock was $77,277 65. The same amount of machinery for a dock at Brooklyn could probably be procured for $75,000; while the cost of pipes for an elevating dock would be $70,000. The cost of draining the present dry dock, including all the expenses of running the steam-engine and pumps, does not exceed thirty dollars: the cost of Croton water, which would be expended in docking a ship on the elevating plan, would doubtless far exceed this amount.

I addressed a communication to the president of the Croton Aqueduct Board, asking information in relation to the cost of water, pipes, &c.; also, the extent of powers vested in the board, in relation to contracts for a supply of water. In answer to this communication, I learned that the directors are only authorized to lease the water for a term of twelve months, or from year to year. The cost of water to supply a dock, is a subject for the consideration of the common council; and that body have arrived at no conclusion upon the question.

With regard to the position at Harlaem, I am unable to discover that it possesses any advantages which entitle it to serious consideration as a proper location for a navy-yard or dry dock; on the contrary, there are many objections to its use for naval purposes. The land is low, and would require a filling of at least twelve feet, over a surface of one hundred acres. To accomplish this work, it would be necessary to resort to the stone ledges west of the third avenue, for materials, there not being a sufficient quantity of earth in the neighborhood. The channel from the present navy-yard to Harlaem river is narrow, with a rocky coast on either side. This location is in the immediate vicinity of the dangerous pass, known as the Great Hellgate, where the currents are so strong and varied, as to render a passage at all times extremely hazardous. In a report in which the adoption of this site was advocated, it is stated that the passage through Hellgate can be used for ships of war. As evidence of this fact, it is stated that the French frigates Dido and Sibelle, and the United States frigates United States and Macedonian, were actually taken through, many years since. This statement is doubtless correct; and the circumstances which induced the commanders of those vessels to venture a passage, were of such a character as to exonerate them from censure for incurring the risk of being wrecked upon the rocks and shoals. In the first instance, the frigates were pursued by an enemy of superior force, and the only escape was through Hellgate; in the latter case, the passage to sea by way of Sandy Hook was blockaded by an enemy's squadron; and the bold and energetic spirit of the

officer commanding those ships could not endure the mortification of remaining in port while the enemies of his country were abroad upon the ocean: he therefore attempted the passage, and succeeded. It may, however, be added, that the English frigate Hussar, in passing this channel, struck upon the rocks and was lost. That the passage is possible, no one can doubt; still it may be safely asserted, that no officer, however bold and skillful, would venture to incur the risk with a heavy ship-of-war under canvass, unless impelled by the most urgent necessity.

I endeavored to ascertain the probable cost of lands at each of the points under examination; but did not succeed in obtaining information of a character sufficiently definite to enable me to form a satisfactory estimate. Leaving the purchase of the necessary lands out of the question, I am of the opinion that the construction of a dry dock, using the Croton water as an elevating power, is inexpedient; and that neither of the points which were examined possesses important advantages, not possessed by the present location at Brooklyn.

My letter of instructions also directs me "to examine the Brooklyn navy-yard, and ascertain the practicability and cost of constructing a floating sectional dock upon Dakin's plan, connected with a railway to take the ships from the dock to the land—the dock and railway to be capable of taking up the largest ships-of the line."

This subject has engaged my particular attention, and I had several opportunities of witnessing the performance of a dock on this plan, which is in daily operation. This dock consists of seven sections, two of which were completed and first used in December 1840; in January, 1841, the third section was added; in July and August, 1841, the fourth and fifth were added; in March, 1842, the sixth was constructed; and in August, 1842, the dock was extended to its present capacity. No accident has yet occurred to this dock, and a statement of the number and description of vessels which have been raised and repaired will afford the best evidence of its safety and utility. The proprietors exhibited their register, by which it appears that the following vessels have been taken out and repaired: 1 sloop of war, 87 ships, 53 barques, 139 brigs, 132 schooners, 17 sloops, 27 pilot boats, and 59 steamboats. Among the steamboats were several of great length and weight. I was present when the Troy, of 295 feet length, was taken out; and made particular observations to ascertain if the boat was strained by the operation. A line of horizontal brackets was placed at intervals of about 12 feet along the centre of the deck; and after the boat was entirely out of the water, no change whatever could be discovered in the line. This afforded satisfactory evidence that the form of the boat was preserved. This dock is a very simple and ingenious contrivance, and its construction and arrangements reflect much credit on the projectors. The lifting power of the dock now in use is 2,140 tons.

The proprietors propose to construct a dock, basin, and three railways, of the following dimensions and powers, for the sum annexed: The extreme breadth of dock 120 feet, and length sufficient to accommodate the Pennsylvania; to be divided into six sections, each to consist of one submerged tank, divided in the centre by a strong partition, and two end-floats; the external dimensions of the tanks to be 86 feet long, 30 feet wide, and 9 feet 6 inches deep; the internal capacity equal to 80 feet length, 26 feet width, and 8 feet depth; the external dimensions of the end floats to be each 25 feet 6 inches long, 16 feet wide, and 9 feet deep; the depth to be immersed by the power of machinery 6 feet. These dimensions will furnish a lifting

power in each tank equal to 532.45 tons, and in each float a power equal to 78.33 tons. There being two floats to each tank, the lifting power to each section will be equal to 689.11 tons, and the six sections will be 4,134.66 tons. The depth of tanks, 9 feet 6 inches, added to the height of keel-blocks, 2 feet 6 inches, will give for the requisite depth of water, over and above the draught of the ship, 12 feet: thus, to dock a ship of 25 feet draught will require 38 feet depth of water. The weight of the ship Pennsylvania, with her armament, stores, and crew, is stated at 5,200 tons; and a dock of lifting power sufficient to raise this weight, would require an additional depth of 2 feet in the tanks, and 40 feet water for use. The several sections of this dock are to be connected by strong beams of oak timber, and they may be arranged to accommodate a vessel of any length from thirty feet to three hundred. On each side of the dock is a strong framing, upon which are placed the steam-engines and machinery for pumping the water from the tanks, and for forcing the floats beneath the water. The proposed basin is to be 250 feet square, and the side-walls 11 feet high: the whole area of the basin to be strongly piled, and covered with a stone floor one foot thick: the piles to be 12 inches diameter, and 4 feet from centre to centre; and all the masonry of the floor and side-walls to be laid in hydraulic cement. The estimate is for three railways, each provided with an hydraulic cylinder of sufficient power to draw on shore the largest ships-of-the-line; also, two steam-engines, each of the power of twenty horses, and provided with all the necessary pumps and fixtures for working the engines and cylinders, one set of bed and sliding-ways, and three sets of hauling beams; the foundations of the railways to be piled; the piles cut off two feet below ordinary high-water, and capped with timbers 12 inches thick; the walls to be 2 feet 6 inches wide at the base, and 2 feet at the top for the side-walls; the centre-walls to be 3 feet at the base, and 2 feet 6 inches at the top; and all the walls to be connected by strong cross-walls.

The process of docking a ship is first to sink the dock to the required depth, by admitting water into the tanks, and elevating the floats by the small engines and machinery; the ship is then placed directly over the centre of the dock, the side-shores arranged, and the pumps are then set in motion. As the water is withdrawn from the tanks, they gradually rise to the surface, and, with them, the ship. As the ship rises from the water, the end-floats are forced down, and secure the stability of the whole structure, while they aid in elevating the ship. After the ship is raised upon the dock, the whole structure is to be floated into the basin, the water again admitted into the tanks, and the dock sunk until it securely rests upon the floor of the basin; a cradle is then to be placed beneath the ship, the hauling-beams attached, the engines and cylinders put in operation, and the ship drawn on shore upon the railways.

The connecting beams are so constructed, that, by keying them firmly after the ship is raised, the several sections become as one structure; and should one end of a tank be filled with water by accident or design, that tank could not sink below the others, it being supported by the connecting beams; the effect of such accident would be, the depression of the side of the dock upon which the tank filled, until the additional displacement became equal to the amount of water admitted into the tank: this effect would be immediately counteracted by driving the end-floats into the water, or by exhausting more water from the remaining tanks. The machinery for working the pumps and end-floats is perfectly simple, and the

connexion of one section with another is accomplished by means of a hollow sliding shaft, with ball and socket joints: the introduction of the ball and socket joints, and moveable shafts, renders it unnecessary to preserve a straight line of shafting, and affords a great facility for extending the sections to any desired length. The power necessary to force an end-float beneath the water is 78.33 tons, and no additional resistance would ever be applied to the machinery used in forcing these floats down. The common lifting pump, with butterfly-valves, is used for exhausting the tanks; and I apprehend no difficulty in constructing all the machinery with sufficient strength to guard against accidents. The pump-work is a small item of expense, and the cost of a duplicate set would be a very inconsiderable amount.

By introducing gauge-rods, properly graduated, the lifting power exerted by each section may be ascertained with mathematical precision; the weight of ships placed upon the docks may thus be readily and accurately obtained. The sections of this dock may be disconnected at pleasure, and formed into two docks of three sections each; or one of four, and the other of two sections; and, if required, may be merged into three docks of two sections each. Such small docks would be capable of taking out brigs or schooners, and could be used independently of each other. The practicability of constructing an hydraulic cylinder of power sufficient to draw the ship from the dock upon a level railway, does not admit of a reasonable doubt, when it is well known that large ships are not only drawn up an inclined plane by the methods usually adopted upon the common marine railway, but are also raised vertically from the water, by means of hydraulic cylinders, as applied at the screw docks. A serious objection, alike common to all plans of floating docks when extended to a capacity sufficient to raise the largest ships-of-the-line under all circumstances, is the great depth of water necessary for their operations. The weight of the Pennsylvania, when ready for sea, is stated to be 5,200 tons, and her draught of water 25 feet. Should it be necessary to dock this ship in such condition, a depth of at least 40 feet would be required. To obtain this great depth at the Brooklyn yard, it will be necessary to perform a large amount of dredging; and to preserve it, there should be a line of crib-work constructed around the wall, about the flats. A line of crib-work 800 feet long, and of proper dimensions and construction, will cost $39,200; and the excavations around the yard will cost the additional sum of $111,158. The proprietors propose to construct a dock, basin, and all the necessary machinery as already described, the dock being capable of raising 5,200 tons, for the following sums:

For the dock, basin, railways, and all machinery - - -	$497,000 00
For 800 running feet of crib-work - - - -	39,200 00
For excavating the channel - - - -	111,158 00
	$647,358 00

The following statement will show the weight and draught of a vessel of each class when in ballast trim.

Names of vessels.	Weight of hull and ballast.	Mean draught.
	Tons.	Feet.
Pennsylvania - - - -	2,876	17.5
North Carolina - - - -	2,268	17
Franklin - - - - -	1,836	16
Congress - - - - -	1,455	15.33
Macedonian - - - -	1,033	14.83
Saratoga - - - - -	536	11.83
Vandalia - - - - -	491	11.53
Yorktown - - - - -	412	11.41
Dolphin - - - - -	140	8.95

A dock of lifting power sufficient to raise the largest ship when relieved from the weight of her armament, stores, &c. would require for its operation a depth of water equal to 14 feet in addition to the draught of the ship. Thus, to dock the Pennsylvania, the requisite depth would be 32 feet; and the cost of a dock, basin, three railways, and all the necessary machinery, would be - - - - - - - $485,000 00
For 800 running feet of crib-work - - - - 39,200 00
For excavating the channel - - - - 43,158 60

$567,358 60

I am of the opinion that the construction of a dock upon this plan, capable of raising the largest ships-of-the-line, would be practicable.

In the performance of the duty assigned me, I have availed myself of all the information to be obtained from the reports of former examinations in relation to the location of dry docks and navy-yards. These surveys and examinations have been attended with much labor and exposure; and I cannot forbear an expression of the great satisfaction I experienced from the prompt and efficient manner in which the several duties were performed by Messrs. George F. De la Roche and Calvin Brown, the gentlemen associated with me.

Very respectfully, your obedient servant,

WM. P. S. SANGER, *Engineer.*

Hon. DAVID HENSHAW,
Secretary of the Navy.